

Generally, floor panels can be subject to shear, tension, and torque as the typical loads that can be applied.

It also should be appreciated that the present spacers can come in different configurations, and the configuration in Figure 1 is provided with a through clearance, but could just as easily be with a through-threaded bore or can include, for example, a floating nut element. Additionally, the spacer can be supplemented with an epoxy potting material to provide a molded-in configuration. The successful application of a spacer into a sandwich structure panel will consider the overall thickness of the panel, face skin thickness, the type of core, and the desirability of a flush mounting with the surface of the face skin.

While the present invention will be described principally with regard to a spacer, for example, that can be used on a floor panel of an integral configuration, it should be appreciated that alternative two-part spacers, which include a plug and sleeve assembly that can be bonded together, or screwed together, can also be advantageously used, particularly by the provision of a sealant material to such spacers. Another type of spacer could be of a grommet type through-rivet spacer configuration, which may advantageously use the teaching of the sealing compound of the present invention.

Referring to Figure 3, a spacer 2 can have its flange 4 coated with an adhesive 26 to enable the flange 4 to be adhered to the bottom surface or face plate 22 of the panel 16. The relative thickness of the panel to that of the height of the spacer 2 positions the entrance rim portion 6 above the surface of the upper face plate 20 by a predetermined distance, for example, for a 0.390 inch thick panel the entrance rim extends above the face skin of the panel by 0.050 inches.

Referring to Figure 4, a first embodiment of a setting tool 28 includes a specially designed contact bi-curved surface 30 for applying force to the upper edge of the rim 6. An alignment guide 32 is dimensioned to fit within the central aperture 10 to ensure the proper alignment of the setting tool 28. In this embodiment, the curved surface extends

5 from the guide 32 with an initial convex surface of 0.176 inches in radius and transforms to a concave surface of 0.328 inches in radius. While not shown, an anvil or supporting tool can be placed opposite the setting tool 28 against the lower resin plate 22. By the proper application of a force with the setting tool 28, the bi-curved contact face surface 30 can force the rim 6 into the body of the panel 16 until it is flush with the surface of

10 the upper face plate 20. The alignment guide 32 is journaled within the central aperture 10 during this procedure. As can be seen in Figure 5, the outer diameter of the rim 6 will also bulge outward in a convex manner beneath the upper face plate 20, as a result of the force transmitted by the curved surface of the face surface 30. This bulging displacement or convex ring will help lock the upper portion of the spacer 2 in the

15 panel 16.

It is highly desirable to seal the spacer 2 to the upper face plate 20, and in this regard, a sealant material, such as a silicone resin from Dow Corning such as a 1-2577 conformed coating, or other sealing compound can be used. In the preferred embodiment, a thermoplastic resin such as a UV Aero-Seal with safety film 616 that is

20 sold by ND Industries of Santa Fe Springs, California, as ND VIBRA-TITE® has been successfully used. This outer sealant material 34 can be seen in Figure 5 and can have a minimum thickness of 0.002 inches annularly about an exterior circumference of the cylindrical entrance rim. It is possible to have an excess of deposited sealing material

and still effectuate a seal, but it is preferable to minimize any post installation clean-up procedure.

Additionally, another thermoplastic resin sealant material 36 can be provided within the spacer 2 to facilitate a further sealing with any fastener, such as a screw with a tapered head that is to be subsequently journaled within the central aperture 10. This sealant material 36 can be an Aero-Seal SB11, again sold by ND Industries. The provision of this outside sealant 34 combined with the deformation of the rim 6 facilitates a liquid tight sealing of the spacer 2 about the perimeter of the bored hole within the upper face plate 20 of the panel 16. Tests have been conducted with water pressure set at 30 psi, and a water-tight seal was maintained by both the spacer and the method of the present invention.

Figure 5 discloses the spacer 2 of the first embodiment with an initial position of the outside sealant 34 and the inside sealant 36 prior to an insulation of the spacer 2 within a bore or hole in a panel 16.

An alternative embodiment of the present invention is disclosed in a spacer 40, as shown in Figures 7 and 11. In this embodiment, an entrance rim 42 is configured to provide a curved annular groove 44 having a vertical radius of about 0.022 inches extending about the inner wall of the entrance rim to facilitate a biasing of an outward convex bulging of the rim 42 when it is subject to an application of a force from the setting tool 28. The inner upper edge 46 of the rim 42 is beveled to complement the curved contact face surface 30 of the setting tool 28 so that a smooth application of force will be generated as the upper edge of the rim 42 is driven down to be flush with the surface of an upper face plate 20, while the outer surface of the rim 42 is cold-worked to form a convex ring beneath the upper face plate 20. The rim 42 can have an outer